

**NECAP 2009 RELEASED INQUIRY TASK
GRADE 11 SCIENCE**

Broad Area of Inquiry: Formulating Questions and Hypothesizing

Inquiry Construct 1: Analyze information from observations, research, or experimental data for the purpose of formulating a question, hypothesis, or prediction.

- ❶ Form a hypothesis about the relationship between the magnitudes and frequency of earthquakes. Explain your thinking.

Scoring Guide

Score	Description
2	Response identifies a reasonable hypothesis and provides a clear explanation.
1	Response identifies a reasonable hypothesis without clear explanation or explanation without hypothesis.
0	Response does not contain any correct elements or is irrelevant.
Blank	No response

Training Notes:

The general relationship between the magnitude and frequency of earthquakes is that large magnitude earthquakes do not occur as frequently as small magnitude earthquakes. While this is the expected response, other hypotheses such as “there is no relationship between magnitude and frequency” are acceptable because the prediction does not have to be “correct” since the students have not done any experiments at this point. However, prediction should be reasonable and related to topic.

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SCORE POINT 2

1

I believe that the smaller the magnitude of an earthquake is, the higher the frequency will be. Smaller earthquakes do not require as much of a disturbance to occur so it is more likely that small earthquakes will happen than larger earthquakes.

The response gives a reasonable hypothesis (the smaller the magnitude the higher the frequency) and offers a logical reason for why the prediction was made.

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SCORE POINT 1

1

The lower the frequency the
higher the magnitude the
higher the frequency the
lower magnitude.

The response states a testable hypothesis with no rationale.

SCORE POINT 0

1

MY Hypothesis about the relationship
between the magnitudes and
frequency of earthquakes
IS they both help gather
information about an
earthquake & to test it

The response does not offer a testable hypothesis for the relationship between magnitude and frequency.

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Broad Area of Inquiry: Conducting Investigations

Inquiry Construct 8: Use accepted methods for organizing, representing, and manipulating data.

- 2 Construct the most appropriate type of graph of the data in Data Table 1 to show the relationship between the **magnitudes** and **frequencies** of earthquakes in Northern California and the Northeast. Make sure your graph includes all of the required elements.

Scoring Guide

Score	Description
3	Any errors do not detract from conveyance of meaning—response shows a thorough ability to construct a graph that conveys meaning.
2	Errors distract from conveyance of meaning—response shows a general ability to construct a graph that conveys meaning.
1	Errors interfere with conveyance of meaning—response shows a minimal ability to construct a graph that conveys meaning.
0	Response does not contain any correct elements or is irrelevant.
Blank	No response

Training Notes:

A bar graph, line graph, or scatter plot is the expected presentation.

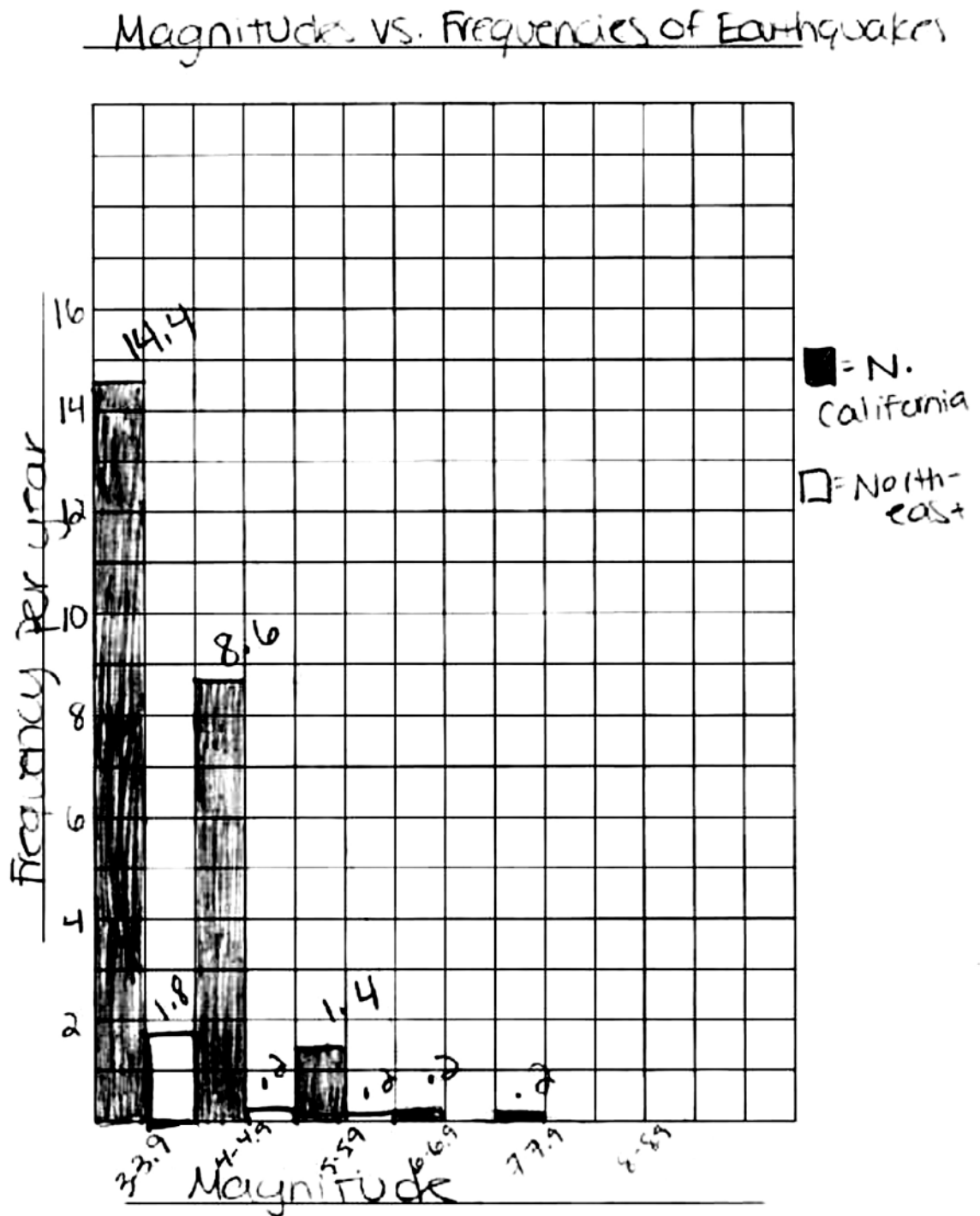
Magnitude should be plotted on the x-axis and Frequency on the y-axis.

If Numbers of Earthquakes are graphed or the axes are flipped, the highest score point is a 1.

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SCORE POINT 3

2

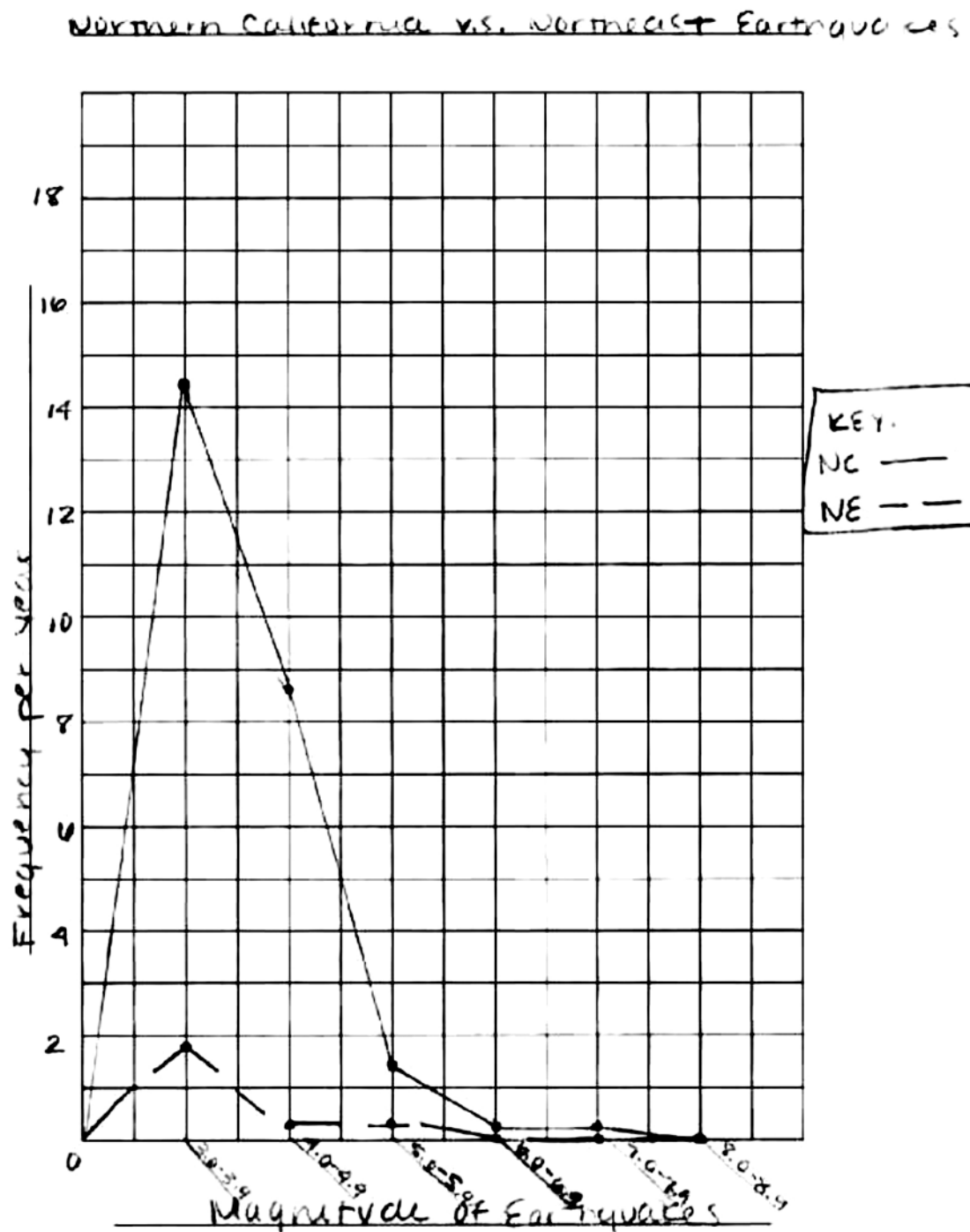


All data bars are the correct height, the scale is consistent and appropriate, both axes are labeled, there is a key to distinguish the data sets, and there is an appropriate title.

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SCORE POINT 2

2



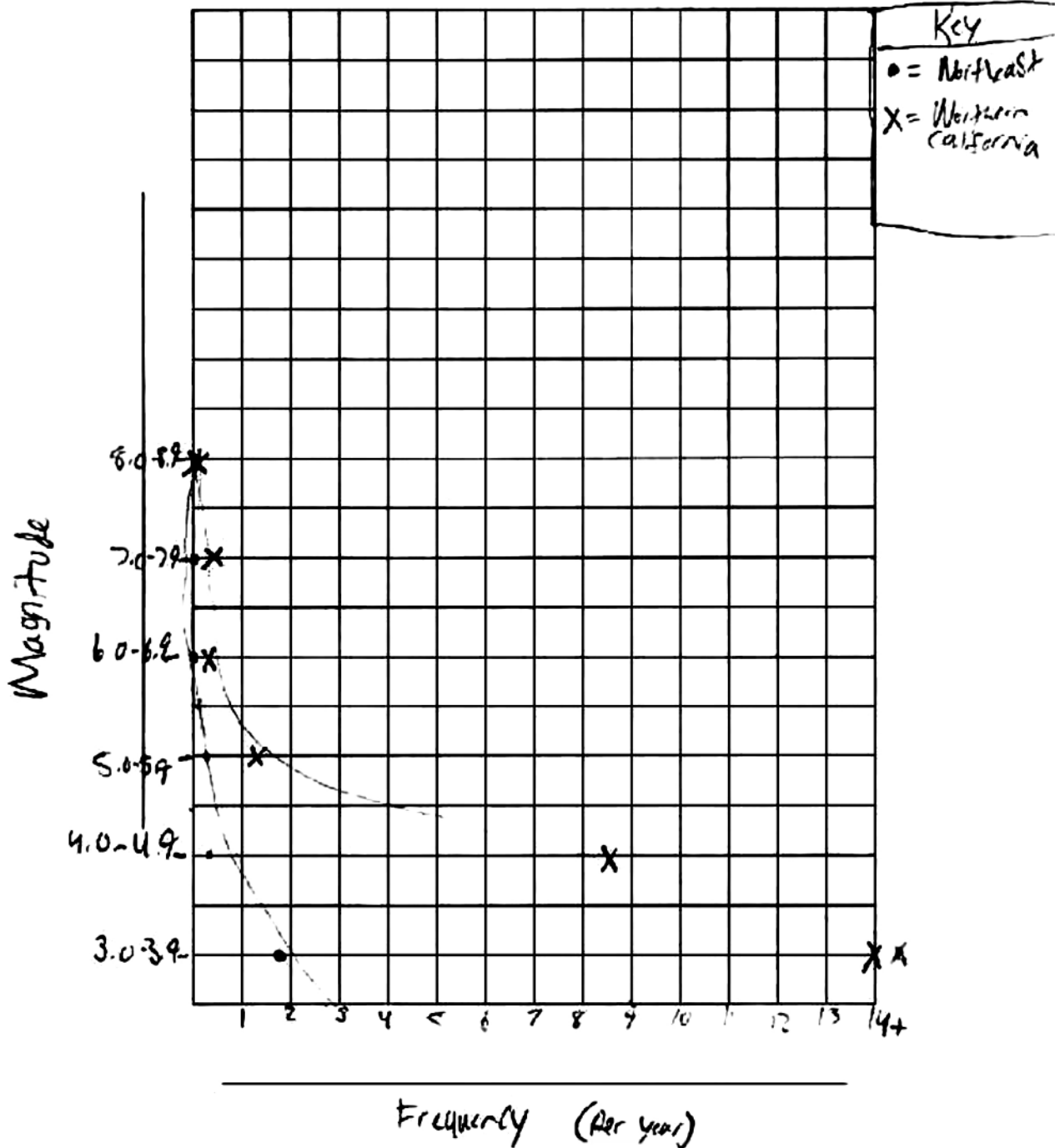
There are a few errors present, but the graph still gets its meaning across. Using (0, 0) as a data point is an error, and the title does not address the independent and dependent variables.

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SCORE POINT 1

2

Frequency of earthquakes in Northern California
and the North east



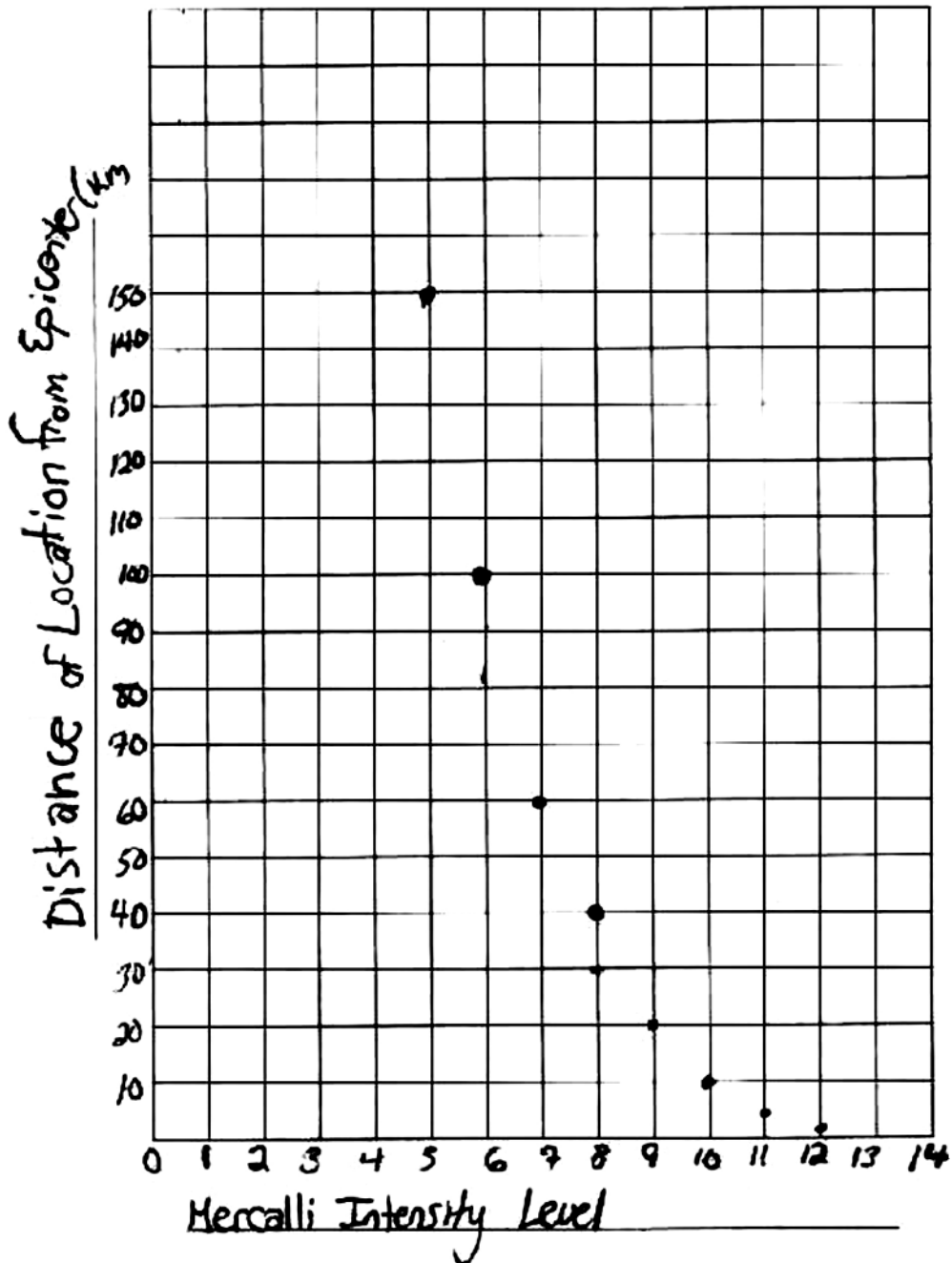
The graph is harder to understand, but there is still some correct work. The axes have been flipped, which is considered a major error (magnitude should be on the x-axis). The title does not address magnitude.

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SCORE POINT 0

2

1994 Northridge Earthquakes



The wrong data set has been graphed.

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Broad Area of Inquiry: Developing and Evaluating Explanations

Inquiry Construct 11: Analyze data, including determining if data are relevant, artifact, irrelevant, or anomalous.

- 3** How does the pattern in the data in Data Table 1 support or refute your hypothesis? Use evidence to explain your answer.

Scoring Guide

Score	Description
2	Response correctly evaluates whether hypothesis is supported or refuted and correctly uses specific evidence to support the answer.
1	Response correctly evaluates whether hypothesis is supported or refuted, or data is used correctly but without reference to hypothesis.
0	Response does not contain any correct elements or is irrelevant.
Blank	No response

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SCORE POINT 2

3

This graph supports my hypothesis. In my hypothesis I stated that as the magnitude increases the frequency decreases, which the graph shows. In northern California, they have had around 72 earthquakes, between 2002-2007, with a magnitude of 3.0-3.9. The Northeast has had 28 with a magnitude of 3.0-3.9. But when the magnitude increases to 4.0-4.9 in Northern California the number drops to 43 earthquakes. In the Northeast that number drops to 4 earthquakes.

The response takes a position (graph supports hypothesis) and gives specific evidence from the graph to support its claim.

1

Hypothesis → As the number of the measured earthquake (magnitude) increases, the frequency decreases.

Reason → My logic for this is the plates are constantly shifting so there will always be little earthquakes. Most of them aren't even felt because they are so small. The larger magnitude, the less common they are.

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SCORE POINT 1

3

The Data does not support my hypothesis because as the frequencies increase, the Magnitudes decrease.

The response takes a position (data does not support my hypothesis), and gives an unspecific statement about the graph.

1

The higher the frequency, the higher the magnitude of the Earthquakes. If a certain location gets many Earthquakes on a regular basis the magnitude will be higher. It would be higher because it is more susceptible¹⁵⁶⁷ to the Earthquakes happening.

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SCORE POINT 0

3

There are more earthquakes in California than the Northeast because Cali is on the edge of a tectonic plate.

The response is irrelevant to the prompt.

1

The frequency is how many earthquakes occur in an area each year at a given magnitude. The magnitude is the measure of an earthquake's size. They are both based off each other.

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Broad Area of Inquiry: Developing and Evaluating Explanations

Inquiry Construct 11: Analyze data, including determining if data are relevant, artifact, irrelevant, or anomalous.

- 4 Compare the data in Data Table 1 with the data in Data Table 2. Which data table would be **more** helpful to determine the possibility of an earthquake with a 5.5 magnitude occurring in Northern California and the Northeast? Use evidence to explain your reasoning.

Scoring Guide

Score	Description
2	Response correctly identifies Data Table 2 and explains reasoning.
1	Response correctly identifies Data Table 2 and does not clearly explain reasoning.
0	Response does not contain any correct elements or is irrelevant.
Blank	No response

Training Notes:

For example, the data in Table 2 would be the most helpful in determining the possibility of a M5.5 earthquake in either region. This is because the data in Table 2 covers a longer time period. A longer period provides a better overall look at the seismic activity in the region. The longer period provides more data, and the more data you have, the better your prediction can be. Also, if there was an anomalously low or high amount of earthquakes one year, this would greatly affect the data from 2002–2007 because it only covers 5 years. With 75 years of data, the anomalies would be averaged out.

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SCORE POINT 2

4

Data Table 2 would be more helpful because it gives a wider range of time where an earthquake could take place because Data Table 2 is of data from the years 1932 to 2007, while Data Table 1 is just from the years 2002 to 2007.

The response correctly identifies Data Table 2 and explains that the wider range of data makes it more helpful.

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SCORE POINT 1

4

Data table 2 - it is more precise.

The response correctly identifies Data Table 2, but the reasoning is very vague.

SCORE POINT 0

4

I think data table 1
would be more helpful because
it gives you more recent numbers

The response does not demonstrate an understanding of sample size.

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Broad Area of Inquiry: Developing and Evaluating Explanations

Inquiry Construct 11: Analyze data, including determining if data are relevant, artifact, irrelevant, or anomalous.

- 5 Use your observations of the pictures to rate the Loma Prieta earthquake's level of **intensity** on the Mercalli scale. Use evidence to explain your rating.

Scoring Guide

Score	Description
2	Identifies Level IX on the Mercalli scale and uses evidence from the Mercalli scale to explain observations.
1	Identifies Level IX on the Mercalli scale and may not use evidence from the Mercalli scale to explain observations.
0	Response does not contain any correct elements or is irrelevant.
Blank	No response

Training Notes:

The estimated Mercalli scale of intensity for the picture is IX because of the notable cracks in the ground and general damage to foundations. However, it is not a X, because the building's foundation is not completely destroyed.

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SCORE POINT 2

5

Intensity Level: IX

Explanation: I think this earthquake is at level IX because the foundation in the picture was cracked and the ground was split.

The response correctly identifies intensity Level IX and gives evidence from each picture that corresponds with the descriptions in the Mercalli scale.

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SCORE POINT 1

5

Intensity Level: IX

Explanation: Because The pictures show exactly what the scale describes with that intens of an earthquake

The response correctly identifies intensity Level IX, but does not use specific observations from the pictures for support.

SCORE POINT 0

5

Intensity Level: 4

Explanation:

huge crack in middle of street, houses cut in half.

The response does not identify the appropriate intensity level, and the observations do not correspond with the level given.

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Broad Area of Inquiry: Developing and Evaluating Explanations

Inquiry Construct 12: Use evidence to support and justify interpretations and conclusions or explain how the evidence refutes the hypothesis.

- 6** Use the evidence listed below to estimate how far Boulder Creek was from the epicenter of the 1989 Loma Prieta earthquake.

- Data Table
- the Mercalli scale
- the pictures of earthquake damage in Boulder Creek

Explain how you used **each** piece of evidence to estimate the distance.

Scoring Guide

Score	Description
2	Response correctly addresses all three points: 1. Observations of the damage in the pictures matched Level IX on the Mercalli scale. 2. According to the data in Table 3, Level IX damage occurs close to the epicenter. 3. The Boulder Creek area was 2 to 4 km from the epicenter of the earthquake.
1	Response generally addresses some of the points.
0	Response does not contain any correct elements or is irrelevant.
Blank	No response

Training Notes:

The estimated Mercalli scale of intensity for the picture is IX because of the notable cracks in the ground and general damage to foundations. Based on Data Table 3, intensity IX ends between 2 and 4 km from the epicenter.

If the response incorrectly identifies the Mercalli grade as VIII, and uses Table 3 to conclude that Boulder Creek is 10–20 km from the epicenter, it would get 2 points.

If the response incorrectly identifies the Mercalli grade as X, it must identify the distance as **less than** 2 km to earn 2 points.

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SCORE POINT 2

6

The data table shows that the Mercalli Intensity level IX would have to be 2-4 km away from the epicenter. The Mercalli Scale also says that a IX earthquake causes severe foundation damage and large cracks in the ground. The pictures show ruined foundations and cracks in the ground. Boulder Creek was 2-4 km away from the epicenter.

The response correctly identifies the distance from the epicenter. The procedure that was used to find the distance is clearly outlined.

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SCORE POINT 1

6

the distance from the
epicenter of the 1989 Loma
Prieta earthquake is about
2 km. away because it was
an intensity level of IX.

The response correctly identifies the lower bound of the distance (2 km), but does not identify the upper bound (4 km). The procedure for finding the distance is also explained poorly.

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SCORE POINT 0

6

I think it was within 100 miles
because there was a lot of damage. The
pictures help to tell me how much damage
there was and the scales help me
to figure out what magnitude the
earthquake could be.

The distance selected is incorrect, and it is unclear what procedure led to the incorrect distance.

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Broad Area of Inquiry: Conducting Investigations

Inquiry Construct 10: Summarize results based on data.

Use the ShakeMap for the 2007 Oakland Earthquake on the Mercalli Scale and ShakeMap Reference Sheet to answer the question.

- 7** The ShakeMap for the 2007 Oakland earthquake identifies the cities of Oakland, Berkeley, Fremont, San Francisco, San Jose, and Vallejo in California. After the Oakland earthquake, the first emergency crews were dispatched to Oakland. To which city should the next emergency crews be sent? Explain your reasoning and use evidence to support your explanation.

Scoring Guide

Score	Description
2	Response indicates that emergency responders would be sent to Berkeley first. Response explains why they would go to Berkeley and uses evidence from the ShakeMap to support answer.
1	Response correctly identifies Berkeley with a limited explanation.
0	Response does not contain any correct elements or is irrelevant.
Blank	No response

Training Notes:

Simply saying that Berkeley is close is not acceptable for a 2. Response must relate distance to intensity.

If the response mentions the red fault lines as evidence for a high intensity level, the highest score is a 1 (e.g., Fremont).

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SCORE POINT 2

7

The next crew should be sent to Berkeley because
it is the closest to Oakland and the closer
the town is to the epicenter the worse the damage.

The response correctly identifies Berkeley as the next town, because it is the next closest town to the epicenter.

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SCORE POINT 1

7

The next city emergency crews should be sent is Berkeley because they would get second from the earthquake. Berkeley is closer than all the other cities.

The response correctly identifies Berkeley as the next town. "Berkeley is closer than all the other cities" is not a sufficient explanation without specifying that it is closer to the epicenter, not just closer to Oakland.

SCORE POINT 0

7

The emergency crew should be sent to Oakland because they were the first one.

Emergency crews are already in Oakland.

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Broad Area of Inquiry: Developing and Evaluating Explanations

Inquiry Construct 12: Use evidence to support and justify interpretations and conclusions or explain how the evidence refutes the hypothesis.

Use the ShakeMap for the 2007 Oakland Earthquake on the Mercalli Scale and ShakeMap Reference Sheet to answer the question.

- 8** Explain the factors that cause differences between earthquakes in Northern California and the Northeast. Use the information provided in this task and what you know about plate tectonics to support your answer.

Scoring Guide

Score	Description
3	The response thoroughly explains factors that cause differences between earthquakes in Northern California and the Northeast. The response uses information from the task and outside knowledge of plate tectonics for support.
2	The response generally explains factors that cause differences between earthquakes in Northern California and the Northeast. The response uses some information from the task and outside knowledge of plate tectonics for support.
1	The response minimally explains factors that cause earthquakes in Northern California or the Northeast. The response may or may not use information from the task and outside knowledge of plate tectonics for support.
0	Response does not contain any correct elements or is irrelevant.
Blank	No response

Training Notes:

Differences between the earthquakes observed in Northern California and in the Northeast:

- The boundary between the Pacific Plate and the North American Plate goes right through California. Earthquakes are caused by motion along plate boundaries, so it would be expected that there are a lot of earthquakes in California and that these earthquakes are larger than those occurring in the Northeast.
- The Northeast is in the middle of the North American Plate, nowhere near a plate boundary. Earthquakes in the Northeast are few and far between, and when they do happen they are relatively small.

For a 3, response must address location on the plates (edges vs. center) rather than just plates.

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SCORE POINT 3

8

The earthquakes are different in Northern Cali than in the Northeast because of the plate boundaries. Northern Cali is located on a plate boundary which makes it more prone to earthquakes caused by collision of plates. The Northeast is not very close to any plate boundaries so earthquakes are less common and with lower magnitudes.

The response discusses both locations and their proximity to plate boundaries. The response also states that earthquakes are caused by the collision of plates, which makes areas closer to boundaries more susceptible to earthquakes.

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SCORE POINT 2

8

The plates are running sideways in the west coast, causing a lot of earthquakes and they are right on the coast while the plates in the east are farther away (they are in the middle of the ocean)

The response generally describes plate motion and the location with respect to plates. The response doesn't mention anything about plate boundaries.

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SCORE POINT 1

8

I think that California has more intense earthquakes more frequently because it is on the coast, almost directly on a plate boundary.

The response mentions that being on a plate boundary would cause more frequent earthquakes, but doesn't mention why. The response also doesn't discuss the Northeast at any point.

SCORE POINT 0

8

Northern California has a more high altitude than Northeast does.

The response does not demonstrate understanding. Altitude does not play a significant role in this interaction.